

S-5/PHSH/CC-12/23

TDP (Honours) 5th Semester Exam., 2023

PHYSICS

(Honours)

TWELFTH PAPER : CC – 12

Full Marks : 60

Time : 3 Hours

*Answer from **both** the Sections as directed.*

The figures in the margin indicate full marks.

*Candidates are required to give their answers
in their own words as far as practicable.*

SECTION—A

1. Answer any **six** of the following questions :

2×6=12

- (a) Write the basic difference between covalent and metallic bondings.
- (b) State Wiedemann-Franz law.
- (c) What are primitive lattice cell and unit cell?
- (d) Define Cooper pair.
- (e) What is ferromagnetic domain?
- (f) Define critical magnetic field.
- (g) What is electrostrictive effect?
- (h) What is reciprocal lattice?

PHSH-5/1502

[Turn Over]

(2)
SECTION—B

There are *four* questions from Question No. 2 to Question No. 5. Answer either (a) **or** (b) from each question given below : 12×4=48

2. (a) (i) What is interplanar distance of lattice planes? With a clear diagram, find the interplanar distance of a lattice plane taking the lattice to be cubic with $a = b = c = 2 \text{ \AA}$.
- (ii) Find the Miller indices of a set of parallel planes which make intercepts in the ratio of $3a : 4b$ on the x and y axes and are parallel to z axis, a, b, c being primitive vectors of the lattice.
- (iii) "Bragg's law is a consequence of the periodicity of the space lattice." Explain.
(1+3)+4+4=12

(OR)

- (b) (i) Constructing the primitive vectors, show that the f.c.c. lattice is a reciprocal of b.c.c. lattice.
- (ii) The Bragg angle corresponding to the first order reflection from (111) planes in a crystal is 30° when X rays of wavelength 1.75 \AA are used, calculate the interatomic spacing.
- (iii) Write short notes on Brillouin zone and van der Waals bonding. 4+4+(2+2)=12

(3)

3. (a) (i) What do you mean by lattice vibration? Write a brief qualitative description of phonon.
- (ii) Classically show that the heat capacity of solid element is proportional to R .
- (iii) Write the discrepancy in the classical theory of specific heat. How did Einstein correct the classical law of specific heat? $(1+3)+4+(2+2)=12$

(OR)

- (b) (i) Write short notes on mobility and conductivity. Define drift velocity.
- (ii) Explain the Drude-Lorentz theory related to free electron.
- (iii) Write the basic difference between ordinary gas and free electron gas. Define density of states. $(3+1)+4+(2+2)=12$

4. (a) (i) Write the basic theory of Hall effect. Set a relation between the Hall coefficient and applied magnetic field.
- (ii) What is superconductor? How does a conductor transform to a superconductor?
- (iii) How does the effective mass of electron vary with acceleration of the electrons moving in the periodic lattice? $(2+2)+(2+2)+4=12$

(4)
(OR)

- (b) (i) Using Kronig-Penney model, explain the formation of Brillouin zone and forbidden zone.
- (ii) Using London equation, calculate the penetration depth.
- (iii) Explain the 'electron-lattice-electron' interaction using BCS theory.

$(4+2)+3+3=12$

5. (a) (i) Write the description of dia-, para- and ferromagnetic materials.
- (ii) Give an account of Langevin's theory of diamagnetism.
- (iii) How does a paramagnetic susceptibility vary with temperature? What is Curie-Weiss law?

$4+4+(2+2)=12$

(OR)

- (b) (i) What is polarization mechanism of di-electric substance?
- (ii) Derive the classical theory of electrical polarizability.
- (iii) Explain the structural piezoelectric effect and pyroelectric effect.
- (iv) Explain Clausius-Mossotti equation.

$3+4+3+2=12$

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